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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/607,513	06/28/2000	Nimrod Megiddo	ARC-00-0030-US1	8338

22462 7590 09/23/2004

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EXAMINER	
THANGAVELU, KANDASAMY	
ART UNIT	PAPER NUMBER
2123	

DATE MAILED: 09/23/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/607,513	MEGIDDO, NIMROD	
	Examiner	Art Unit	
	Kandasamy Thangavelu	2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 June 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-36* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-36* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Introduction

1. This communication is in response to the Applicant's Response mailed on June 11, 2004. Claims 1-36 of the application are pending. This office action is made final.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

3. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. Claims 1, 3-10, 12, 13, 15-22, 24, 25, 27-34 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Viniotis et al. (VI)** ("Linear programming ... Queueing systems", IEEE, 1988) in view of **Schneider et al. (SC)** ("Stochastic Production scheduling ... demand forecasts", IEEE, 1998).

4.1 **VI** teaches Linear programming as a technique for optimization of queuing systems. Specifically, as per Claim 13, **VI** teaches solving stochastic control problems of linear systems in high dimensions (Page 652, CL1, Para 1; Page 653, CL2, Para 3); comprising:

modeling a structured Markov Decision Process (MDP) (Page 652, CL1, Para 4; Page 652, CL2, Para 6), wherein a state space for the MDP is a polyhedron in a Euclidean space (Page 654, CL2, Lemma 2);

one or more actions that are feasible in a state of the state space are linearly constrained with respect to the state (Page 653, CL1, Para 1 and Para 2; Page 652, CL2, Para 8); and

building a value function for the state using representations that facilitate the computation of approximately optimal actions at any given state by linear programming (Page 653, CL1, Para 9 to Page 654, CL1, Para 4; Page 652, CL2, Para 8).

VI does not expressly teach a computerized apparatus for solving stochastic control problems of linear systems in high dimensions comprising a computer. **SC** teaches a computerized apparatus for solving stochastic control problems of linear systems in high dimensions comprising a computer (Page 2726, CL1, Para 3 and 4), as that allows the solution of stochastic control problems of linear systems in high dimensions run faster and allows the user to generate the results with varying data (Page 2726, CL1, Para 3). It would have been obvious to

one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **SC** that included a computerized apparatus for solving stochastic control problems of linear systems in high dimensions comprising a computer type, as that would allow the solution of stochastic control problems of linear systems in high dimensions run faster and allow the user to generate the results with varying data.

VI does not expressly teach logic performed by the computer, for modeling a structured Markov Decision Process (MDP). **SC** teaches logic performed by the computer, for modeling a structured Markov Decision Process (MDP) (Page 2726, CL1, Para 3 and 4), as that allows the solution of stochastic control problems of linear systems in high dimensions run faster and allows the user to generate the results with varying data (Page 2726, CL1, Para 3). It would have been obvious to one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **SC** that included logic performed by the computer, for modeling a structured Markov Decision Process (MDP), as that would allow the solution of stochastic control problems of linear systems in high dimensions run faster and allow the user to generate the results with varying data.

VI does not expressly teach logic performed by the computer, for building a value function for the state using representations that facilitate the computation of approximately optimal actions at any given state by linear programming. **SC** teaches logic performed by the computer, for building a value function for the state using representations that facilitate the computation of approximately optimal actions at any given state by linear programming (Page 2726, CL1, Para 3 and 4), as that allows the solution of stochastic control problems of linear systems in high dimensions run faster and allows the user to generate the results with varying

data (Page 2726, CL1, Para 3). It would have been obvious to one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **SC** that included logic performed by the computer, for building a value function for the state using representations that facilitate the computation of approximately optimal actions at any given state by linear programming, as that would allow the solution of stochastic control problems of linear systems in high dimensions run faster and allow the user to generate the results with varying data.

VI does not expressly teach logic performed by the computer, for building one or more approximations from above and from below to a value function for the state using representations. **SC** teaches logic performed by the computer, for building one or more approximations from above and from below to a value function for the state using representations (Page 2722, CL1, Para 2; Page 2724, CL2, Para 6), as value function approximation is an effective technique for both deterministic and noisy scenarios (Page 2722, CL1, Para 2); and approximation allows solving large scale MDPs (Page 2722, CL2, Para 2). It would have been obvious to one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **SC** that included logic performed by the computer, for building one or more approximations from above and from below to a value function for the state using representations, as value function approximation would be an effective technique for both deterministic and noisy scenarios and approximation allows solving large scale MDPs.

Per Claim 15: **VI** teaches that the action space and the state space are continuous and related to each other through a system of linear constraints (Page 652, CL2, Para 7; Page 653, CL1, Para 1).

4.2 As per Claim 16, **VI** and **SC** teach the apparatus of Claim 13. **VI** teaches that the value function is convex (Page 652, CL1, Para 4).

VI does not expressly teach that the logic further comprises efficiently learning the value function in advance and representing the value function in a way that allows for real-time choice of actions based thereon. **SC** teaches that the logic further comprises efficiently learning the value function in advance and representing the value function in a way that allows for real-time choice of actions based thereon (Page 2722, CL1, Para 2), as that allows producing a time-dependent action policy specifically built to match the current demand forecasts and other system states (Page 2724, CL2, Para 4). It would have been obvious to one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **SC** that included the logic further comprising efficiently learning the value function in advance and representing the value function in a way that allows for real-time choice of actions based thereon, as that would allow producing a time-dependent action policy specifically built to match the current demand forecasts and other system states.

4.3 As per Claim 17, **VI** and **SC** teach the apparatus of Claim 13. **VI** teaches that the linear function is represented by piecewise linear and convex functions (Page 652, CL1, Para 4; Page 654, CL1, Lemma 1).

VI does not expressly teach the linear function is approximated both from above and from below by piecewise linear and convex functions. **SC** teaches the linear function is approximated both from above and from below (Page 2722, CL1, Para 2; Page 2724, CL2, Para 6), as value function approximation is an effective technique for both deterministic and noisy scenarios (Page 2722, CL1, Para 2); and approximation allows solving large scale MDPs (Page 2722, CL2, Para 2). It would have been obvious to one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **SC** that included the linear function being approximated both from above and from below, as value function approximation would be an effective technique for both deterministic and noisy scenarios and approximation allows solving large scale MDPs.

Per Claim 18: **VI** teaches that the domains of linearity of the piecewise linear and convex functions are not stored explicitly, but rather are encoded through a linear programming formulation (Page 652, CL1, Para 4; Page 654, CL1, Lemma 1; Page 653, CL1, Para 9 to Page 654, CL1, Para 4).

4.4 As per Claim 19, **VI** and **SC** teach the apparatus of Claim 17. **VI** teaches that the domains of linearity of the piecewise linear and convex functions allow the functions to be optimized and updated (Page 652, CL1, Para 4; Page 654, CL1, Lemma 1; Page 654, CL1, Para 6 to Para 8).

VI does not expressly teach that the domains of linearity of the piecewise linear and convex functions allow the functions to be optimized and updated in real-time. **SC** teaches that

the domains of linearity of the functions allow the functions to be optimized and updated in real-time (Page 2722, CL1, Para 2; Page 2724, CL2, Para 6), as that allows producing a time-dependent action policy specifically built to match the current demand forecasts and other system states (Page 2724, CL2, Para 4). It would have been obvious to one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **SC** that included the domains of linearity of the functions allowing the functions to be optimized and updated in real-time, as that would allow producing a time-dependent action policy specifically built to match the current demand forecasts and other system states.

4.5 As per Claim 20, **VI** and **SC** teach the apparatus of Claim 13. **VI** does not expressly teach that the value function can be efficiently approximated both from above and from below. **SC** teaches that the value function can be efficiently approximated both from above and from below (Page 2722, CL1, Para 2; Page 2724, CL2, Para 6), as value function approximation is an effective technique for both deterministic and noisy scenarios (Page 2722, CL1, Para 2); and approximation allows solving large scale MDPs (Page 2722, CL2, Para 2). It would have been obvious to one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **SC** that included the value function being efficiently approximated both from above and from below, as value function approximation would be an effective technique for both deterministic and noisy scenarios and approximation allows solving large scale MDPs.

4.6 As per Claim 21, **VI** and **SC** teach the apparatus of Claim 13. **VI** does not expressly teach that the approximations can be repeatedly refined. **SC** teaches that the approximations can be repeatedly refined (Page 2725, CL2, Para 4), as that allows producing a time-dependent action policy specifically built to match the current demand forecasts and other system states (Page 2724, CL2, Para 4). It would have been obvious to one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **SC** that included the approximations being repeatedly refined, as that would allow producing a time-dependent action policy specifically built to match the current demand forecasts and other system states.

4.7 As per Claim 22, **VI** and **SC** teach the apparatus of Claim 13. **VI** does not expressly teach that the value function can be efficiently approximated from above based on knowledge of upper bounds on the function at each member of a selected set of states. **SC** teaches that the value function can be efficiently approximated from above based on knowledge of upper bounds on the function at each member of a selected set of states (Page 2722, CL1, Para 2; Page 2724, CL2, Para 6; Page 2725, CL2, Para 3), as value function approximation is an effective technique for both deterministic and noisy scenarios (Page 2722, CL1, Para 2); and approximation allows solving large scale MDPs (Page 2722, CL2, Para 2). It would have been obvious to one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **SC** that included the value function being efficiently approximated from above based on knowledge of upper bounds on the function at each member of a selected set of states, as value function approximation would be an effective technique for both deterministic and noisy scenarios and approximation allows solving large scale MDPs.

4.8 As per Claim 24, **VI** and **SC** teach the apparatus of Claim 13. **VI** does not expressly teach that the value function can be approximated successively. **SC** teaches that the value function can be approximated successively (Page 2725, CL2, Para 4), as that allows producing a time-dependent action policy specifically built to match the current demand forecasts and other system states (Page 2724, CL2, Para 4). It would have been obvious to one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **SC** that included the value function being approximated successively, as that would allow producing a time-dependent action policy specifically built to match the current demand forecasts and other system states.

4.9 As per Claims 1, 3-10, 12, 25, 27-34 and 36, these are rejected based on the same reasoning as Claims 13, 15-22, 24, supra. Claims 1, 3-10, 12, 25, 27-34 and 36 are computer based method and article of manufacture embodying computer logic claims reciting the same limitations as Claims 13, 15-22 and 24, as taught throughout by **VI and SC.**

5. Claims 2, 14 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Viniotis et al. (VI)** ("Linear programming … Queueing systems", IEEE, 1988) in view of **Schneider et al. (SC)** ("Stochastic Production scheduling … demand forecasts", IEEE, 1998), and further in view of **Dangat et al. (DA)** (U.S. Patent 5,971,585).

5.1 As per Claim 14, **VI** and **SC** teach the apparatus of Claim 13. **VI** does not expressly teach that the MDP comprises a supply chain planning process. **DA** teaches that the MDP comprises a supply chain planning process (Abstract; CL1, L7-21; CL6, L5-9), as that provides a computerized decision support tool to generate a best can do (BCD) match between existing assets and demands across multiple manufacturing and other facilities based on process flows and business policies (Abstract). It would have been obvious to one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **DA** that included the MDP comprising a supply chain planning process, as that would provide a computerized decision support tool to generate a best can do (BCD) match between existing assets and demands across multiple manufacturing and other facilities based on process flows and business policies.

5.2 As per Claims 2 and 26, these are rejected based on the same reasoning as Claim 14, supra. Claims 2 and 26 are computer based method and article of manufacture embodying computer logic claims reciting the same limitations as Claim 14, as taught throughout by **VI, SC** and **DA.**

6. Claims 11, 23 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Viniotis et al. (VI)** ("Linear programming … Queueing systems", IEEE, 1988) in view of **Schneider et al. (SC)** ("Stochastic Production scheduling … demand forecasts", IEEE, 1998), and further in view of **Hedlund et al. (HE)** ("Optimal control of hybrid systems", IEEE 1999).

6.1 As per Claim 23, **VI** and **SC** teach the apparatus of Claim 13. **VI** does not expressly teach that the value function can be efficiently approximated from below based on linear functions that lie below the convex value function. **HE** teaches that the value function can be efficiently approximated from below based on linear functions that lie below the convex value function (Page 3972, CL1, Para 1; Page 3973, CL1, Para 3; Page 3977, CL1, Para 1), as that would provide a lower bound on the optimal cost in terms of linear programming (Page 3972, CL2, Para 2). It would have been obvious to one of ordinary skill in the art at the time of Applicant's invention to combine the method of **VI** with the apparatus of **DA** that included the value function being efficiently approximated from below based on linear functions that lied below the convex value function, as that would provide a lower bound on the optimal cost in terms of linear programming.

6.2 As per Claims 11 and 35, these are rejected based on the same reasoning as Claim 23, supra. Claims 11 and 35 are computer based method and article of manufacture embodying computer logic claims reciting the same limitations as Claim 23, as taught throughout by **VI, SC** and **HE.**

Response to Arguments

7. Applicant's arguments filed on June 11, 2004 have been fully considered. Applicant's arguments filed on June 11, 2004 under 35 U.S.C.

103 (a) are not persuasive.

7.1 As per the applicant's argument that "the Office Action asserts that Viniotis teaches a state space for the MDP is a polyhedron in a Euclidean space, at Page 654, CL2, Lemma 2; however, at the indicated location, Viniotis merely states … in Viniotis, A is a constraint matrix, not a state space; moreover, Viniotis does not refer to a polyhedron in Euclidean space", the examiner respectfully disagrees.

Viniotis states that the solution to the Linear Programming problem is an extreme point (Page 654, CL4, Para 6); extreme points form a polyhedron (Page 654, CL4, Para 6). One of ordinary skill in the art would have known that such polyhedron existed in the Euclidean space (a multi-dimensional space). The constraints of the linear program are lines in the multi-dimensional space forming the edges of the polyhedron. The constraints are defined by the states. Therefore, the state space of the linear program exists in an Euclidean space and is defined by a polyhedron. It is well known that a Markov decision Problem (MDP) is equivalent to a Linear Program; a MDP problem can be generally formulated as an equivalent Linear Program (Page 652, CL1, Para 4). Therefore, one of ordinary skill in the art would conclude that a state space for the MDP is a polyhedron in a Euclidean space.

7.2 As per the applicant's argument that "the Office Action asserts that Viniotis teaches one or more actions that are feasible in a state of the state space are linearly constrained with respect to the state at Page 653, CL1, Para 1 and Para 2; Page 652, CL2, Para 7; however, at the indicated locations, Viniotis merely states …it can be seen that Viniotis teaches only that a linear

cost functional that involves the state is linear; however, these portions in Viniotis do not teach or suggest that actions that are feasible in a state of the state space are linearly constrained with respect to the state in the context where a state space for the MDP is a polyhedron in a Euclidian space", the examiner respectfully disagrees.

Viniotis states that the state is a linear function of the control actions (Page 652, CL2, Para 8). One of ordinary skill in the art knows that if x is a linear function of y, then y is a linear function of x. Therefore, it is clear that actions are linear functions of state. Selecting an optimal policy (set of actions) reduces to minimizing a linear functional; this minimization is constrained, since the states generated by the policy have to belong to the state space, a subset of nonnegative integers (Page 653, CL1, Para 1). Therefore, it is obvious that the actions are constrained by the state, where the state space is in the Euclidean space.

7.3 As per the applicant's argument that "the Office Action asserts that Viniotis teaches building a value function for the state using representations that facilitate the computation of approximately optimal actions at any given state by linear programming at Page 653, CL1, Para 9 to Page 654, CL1, Para 4 and Page 652, CL2, Para 8; ... Viniotis merely states ...it can be seen that Viniotis teaches only the formulation of an MDP and the definition of a value function; however, the indicated locations in Viniotis cannot be interpreted as teaching the limitations of the applicant's claim directed to "building approximations from above and from below to a value function for the state using representations that facilitate the computation of approximately optimal actions at any given state by linear programming" ", the examiner takes the position that

the examiner used the above section as reference only for building a value function for the state using representations and facilitating the computation of approximately optimal actions at any given state by linear programming.

7.4 As per the applicant's argument that "the Office Action asserts that Schneider teaches building a value function for the state using representations that facilitate the computation of approximately optimal actions at any given state by linear programming at Page 2726, CL1, Para 3 and 4; ... Schneider merely states ...it can be seen that Schneider teaches only a Markov Decision Process ...", the examiner takes the position that the examiner used the above section as reference only for teaching a computerized apparatus for solving stochastic control problems of linear systems in high dimensions comprising a computer and a logic performed by a computer for modeling a structured Markov Decision Process.

7.5 As per the applicant's argument that "the Office Action states that Schneider teaches building one or more approximations from above and from below to a value function for the state using representations at Page 2722, CL1, Para 2 and Page 2724, CL2, Para 6; ... however, the indicated sections in Schneider cannot be interpreted as teaching "building approximations from above and from below to a value function for the state using representations that facilitate the computation of approximately optimal actions at any given state by linear programming", the examiner respectfully disagrees.

Schneider teaches that the solution to the MDP is a value function and a method for generating an approximate value of this function (Page 2722, CL1, Para 2). Schneider also teaches that the solution to an MDP is an approximate value function (Page 2724, CL2, Para 6). Schneider teaches that the value function can be represented as a function of states and actions (Page 2725, CL1, Para 1). Trajectories through the MDP model are generated repeatedly using the current approximation of the value function (Page 2725, CL2, Para 4). For noisy versions, one could use noisy outcomes directly from the stochastic simulation (Page 2726, CL1, Para 3). It is inherent that when noise is introduced, the approximations to the value function will be determined by the amplitude of the noise and will thus be limited from above and from below.

Conclusion

ACTION IS FINAL

8. Applicant's arguments with respect to claim rejections under 35 USC 103 (a) are not persuasive. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Kandasamy Thangavelu whose telephone number is 703-305-0043, till October 27, 2004 and 571-272-3717 after October 27, 2004. The examiner can normally be reached on Monday through Friday from 8:00 AM to 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kevin Teska, can be reached on (703) 305-9704, till October 27, 2004 and 571-272-3716 after October 27, 2004. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-9600.

K. Thangavelu
Art Unit 2123
September 8, 2004

KEVIN J. TESKA
SUPERVISORY
PATENT EXAMINER